

# Coverage Edit Followup System Requirements Study

## FINAL REPORT

This evaluation study reports the results of research and analysis undertaken by the U.S. Census Bureau. It is part of a broad program, the Census 2000 Testing, Experimentation, and Evaluation (TXE) Program, designed to assess Census 2000 and to inform 2010 Census planning. Findings from the Census 2000 TXE Program reports are integrated into topic reports that provide context and background for broader interpretation of results.

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## **PREFACE**

### **Purpose of the System Requirements Study**

The main objective of the System Requirements Study is to assess the efficacy of the requirements definition processes that were employed by the U.S. Census Bureau during the planning stages of the Census 2000 automated systems. Accordingly, the report's main focus is on the effectiveness of requirements methodologies, including processes for coordination, communication, and documentation, and their impact on overall system functionality. The report also addresses certain contract management issues and their effect on system development and/or operational considerations.

The System Requirements Study synthesizes the results from numerous interviews with a range of personnel--both U.S. Census Bureau staff and contractors--who were involved with the planning, development, operations, or management of Census 2000 systems. Our findings and recommendations in this report are qualitative in nature; they are based on the varied opinions and insights of those personnel who were interviewed. The intent is to use the results from this study to inform planning for future systems.

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## EXECUTIVE SUMMARY

The Coverage Edit Followup program was a large-scale effort designed to provide outbound calling services from a network of 13 call centers as a means to resolve coverage edit failures. The system was developed within a very strict timeframe using many of the same U.S. Census Bureau and contractor resources devoted to the development of the Telephone Questionnaire Assistance program. Telephone Questionnaire Assistance provided inbound calling services to answer questions from the public about Census 2000 including the ability to conduct a phone interview for completing short form census questionnaires. This study presents information based on debriefings of personnel involved in the Coverage Edit Followup program.

Census 2000 was the first use of outbound calling combined with an automated, scripted instrument to collect the necessary census data. An estimated 3.1 million cases were anticipated for the system with 2.36 million cases actually identified for followup. The program commenced on May 8, 2000 and was scheduled for completion on June 15, 2000. Telephone followup was extended through August 13, 2000 to permit followup with language difficulty cases and to maximize the number of households for which the U.S. Census Bureau could obtain a completed interview. Coverage Edit Followup had a 70.8 percent completion rate for cases with a valid telephone number. Major results of the study include:

- Requirements defined late in the process. The call center infrastructure and automated features used for Telephone Questionnaire Assistance provided the foundation for the implementation of Coverage Edit Followup. It was known that some form of outbound calling services would be used in Census 2000 when the Telephone Questionnaire Assistance contract was awarded to Electronic Data Systems; however, the scope and specific requirements for the program were not defined until very late in the development process. Given the timeframe for development, not all requirements were implemented and testing was limited. Regardless of the tremendous pressures and issues associated with its development, the contractor and government personnel provided exceptional support and dedication to ensure that Coverage Edit Followup was successfully implemented.
- Some evaluation requirements were not included. Compromises on evaluation data requirements for Coverage Edit Followup were made because of the limited development time. Although these compromises were made through negotiations between subject matter experts and program managers, the lack of some data from the operation may impact the completeness of post-census Evaluation I-1, Coverage Edit Followup for Census 2000.

These and other findings have led to the following key recommendations:

- **Project planning - begin development early. Development efforts must be initiated early enough so that fully tested, robust systems are available for the Dress Rehearsal. Although requirements may change from the lessons learned in Dress Rehearsal and from external forces, there would be a higher chance that all**

requirements would be identified and implemented. In the case of Coverage Edit Followup, requirements were not available until after contract award.

- **Project planning - establish realistic development timelines.** For each development effort, timelines must consider the complexities associated with translating and implementing high-level user requirements into a functional system. In addition, time for testing and rework is required to ensure that each system is sufficiently stable for production. Electronic Data Systems planned a development timeline and methodology based on the system requirements and the limited timeframe available for development and testing. The decision to delay outsourcing, the lack of funding for development until fiscal year 1999, the complexity of requirements, and other factors limited the team's ability to implement all steps required of a systematic methodology.
- **System development methodology - establish agency-wide guidance.** A standardized methodology provides the agency with a framework for project planning and management and provides a contractor with guidance for the technical approach, types of documentation, and level of detail appropriate for each phase of the development life-cycle. It is recommended that the U.S. Census Bureau establish an agency-wide system development life-cycle methodology using input from other federal agencies and established industry standards.

## 1. BACKGROUND

The Titan Systems Corporation, System Resources Division (Titan/SRD) was tasked by the Planning, Research, and Evaluation Division (PRED) of the U.S. Census Bureau to conduct system requirements studies for 12 automated systems used in the decennial census. This report is a study of the Coverage Edit Followup (CEFU) system. It addresses the extent to which the requirements definition process was successful in identifying the needed system functionality and offers one of several evaluation approaches for examining these automated systems. The report results are intended to assist in the planning of similar systems for the 2010 census.

The objective of CEFU was to improve within household coverage by resolving coverage edit failures. Coverage edit failures include both count discrepancies and large household followup. Count discrepancies occur when the population count on the form covers or the roster on the long form differs from the number of person columns filled in with information. Count discrepancies require followup to correctly identify the number of persons that should be recorded for that household. Large household followup is required because households larger than six persons cannot record data for all persons associated with the household. For households that completed a Be Counted form, only five person columns for providing data were available. There is room on the form to include the names of the individuals, but not any demographic information. No housing data were collected.

There were four major aspects to the CEFU system: telephone number appending and verification, case management software, predictive dialing, and the operator support system. Each case for CEFU was identified from respondent provided data. Telephone numbers were identified for the cases, as necessary, and existing telephone numbers were validated to ensure that the combination of area code and prefix were legitimate. Calls were made from an infrastructure of 13 call centers. Case management software used variables such as form type, language, and case type to assign the cases to each call center. Predictive dialers called the household and agents used the operator support system to ask the appropriate screener questions and populate the automated instrument. The CEFU operation provided for 12 calls to make an initial contact with an eligible respondent and 12 more calls to complete the interview for that household. The language used for the outbound call was determined by the language of the mail return. The operator support system also provided agents access to the on-line reference database of census related information (i.e., Automated Questionnaire Reference Book).

An estimated 3.1 million cases were anticipated for followup; 2.36 million cases were actually submitted to the CEFU operation. The original Request for Proposal (RFP) estimated between 580,000 and 4.5 million cases, showing the variability of the workload. The targeted completion rate was 80 percent of all cases with a valid telephone number. This target was suggested by the contractor before all requirements had been defined by the Census Bureau. Completes include three types of resolved cases: "count complete," "sufficient partial," and "fully complete."

## **2. METHODOLOGY**

The Titan/SRD Team interviewed key personnel for each of the Census 2000 automated systems using a structured approach centered around four fundamental areas. A set of questions under each of those areas was designed to explore: (1) the effectiveness of the requirements definition process; (2) how well the systems were aligned with business processes; (3) identification of any deficiencies in functionality or performance relative to actual operational needs; and (4) how effective the agency contract management activities were in regards to contractor performance.

A similar, but separate set of questions, was designed for the contractors who were identified as key personnel. The contractors were asked about the following areas: (1) the clarity of the statement of work and the impact of any changes to the specifications; (2) their interactions with government personnel and the technical direction they received; (3) the timeline for completing the work; and (4) their impressions of the system's suitability and operational effectiveness.

The purpose of the system requirements study is to summarize the results of interviews with key personnel by system. A variety of related system documentation was reviewed in connection with the interviews. The assessments provided in Section 4., Results, reflect the opinions and insights of key personnel associated with CEFU who were interviewed by the Titan/SRD Team in September 2000. Those personnel had varying levels of knowledge about the CEFU system based on their involvement with system planning, development, implementation, or operational issues. Section 5., Recommendations, provides value-added perspectives from the Titan/SRD Team that seek to illuminate issues for management consideration in the planning of future systems.

Quality assurance procedures were applied to the design, implementation, analysis, and preparation of this report. The procedures encompassed methodology, specification of project procedures and software, computer system design and review, development of clerical and computer procedures, and data analysis and report writing. A description of the procedures used is provided in the "Census 2000 Evaluation Program Quality Assurance Process."

Study participants reviewed the results of this system requirements study. Comments have been incorporated to the fullest possible extent.

## **3. LIMITS**

The following limits may apply to this system requirements study:

- The perception of those persons participating in the interview process can significantly influence the quality of information gathered. For instance, if there is a lack of communication about the purpose of the review, less than optimal results will be obtained and the findings may lack depth. Each interview was prefaced with an explanation about its purpose in order to gain user understanding and commitment.

- In some cases, interviews were conducted several months, even years, after the participant had been involved in system development activities. This extended timeframe may cause certain issues to be overlooked or expressed in a different fashion (i.e., more positive or negative) than if the interviews had occurred just after system deployment.
- Each interview was completed within a one to two hour period, with some telephone followup to solicit clarification on interview results. Although a detailed questionnaire was devised to guide each interview and gather sufficient information for the study, it is not possible to review each aspect of a multi-year development cycle given the limited time available with each participant. Although this is a limitation, it is the opinion of the evaluators that sufficient information was gathered to support the objectives of the study.
- Every effort was made to identify key personnel and operational customers who actively participated in development efforts. In the case of CEFU, all government personnel who participated in the CEFU study are still with the Census Bureau. The contractor interviewed for the study is no longer active on the CEFU program.

## 4. RESULTS

This section contains findings that relate to the effectiveness of the requirements definition process used during the development of CEFU. The requirements process establishes the foundation for a system and, as such, must be designed to thoroughly consider all technical and functional aspects of development and operation of the system.

### 4.1 Requirements definition

The concept of using followup procedures to resolve coverage edit failures existed prior to the development of CEFU. Three modes of followup were tested including the use of a personal visit to add or correct information, a form to correct original information submitted by the household, and a telephone followup. In the 1990 Census, telephone followup was used with a paper and pencil questionnaire. Unresolved cases from the telephone operation went to field followup for a personal visit. These modes were deemed unsuitable to Census Bureau's needs: the telephone followup lacked structure; the personal visit mode was considered costly. The Dress Rehearsal in 1998 used mail to distribute forms for collecting the additional information required for large household followup; the mail form had an unacceptable response rate. A telephone operation was also used for count discrepancy cases. For Census 2000, the personal visit mode was not used because it would have impacted Accuracy and Coverage Evaluation (A.C.E.) and associated work. The automated instrument used in Census 2000 underwent cognitive testing and appears to have been a major improvement in the efficiency and accuracy of data collection.

When the contract for development of the inbound calling service (i.e., Telephone Questionnaire Assistance (TQA)) was issued there was reference to the need for an outbound calling service;

however, the requirements for this service were not fully defined at that time. The definition of the requirements occurred after the inbound calling service development was well underway. A cross-divisional team approach was used to identify the necessary functionality. This team involved representatives from the Decennial Systems and Contracts Management Office (DSCMO), Decennial Management Division (DMD), Population Division (POP), and Decennial Statistical Studies Division (DSSD).

A Change Control Board (CCB) consisting of DSCMO and contractor staff was established to manage any additions or changes that were necessary to implement the required CEFU functionality. The CCB evaluated each change with input from the contractor and then made the determination as to whether the change would be implemented. Decisions from the CCB were documented.

Project management staff and contractor personnel formed a close working relationship and were in constant communication throughout the project. Several types of meetings were conducted including Monthly Status Meetings and periodic Executive Oversight Meetings. The Monthly Status Meetings were open to divisions to attend, but the Executive Oversight Meetings were intended for DSCMO and EDS. There were also weekly conference calls to discuss OSS development, testing, and quality assurance. As the weekly meetings ended in late February 2000, it became problematic for CEFU since no status information was being communicated while the system was still in the development and testing phase. The intent of these meetings was to share status and schedule information with team members as well as identify and resolve critical issues. However, some team members expressed concern that only a limited number of subject matter experts were included and information from these meetings was not always communicated. Communication problems within Census Bureau may have stemmed from a misinterpretation of the roles and responsibilities with respect to the flow of information.

## **4.2 Requirements issues**

### *4.2.1 Agency endorsed methodology was not available*

There is no agency-wide methodology to address requirements definition or system development within the Census Bureau. For CEFU, a cross-divisional team approach was used to define the requirements. Team members included a subset of representatives from the TQA program. Team meetings were conducted to identify and resolve issues and meeting minutes were prepared and distributed. No guidance was available as to the steps necessary for a successful development effort, the required documentation, and the level of detail for each required document. Census Bureau personnel relied on their own experiences and common sense to plan and manage the program. The prime contractor did have internal procedures and methodologies to plan and manage large-scale development and integration projects. These techniques benefited the Census Bureau personnel by providing exposure and insight into acceptable industry standards; however, the contractor model was not always implemented as designed.

### *4.2.2 Requirements were defined late in the process*

Requirements for CEFU were identified late in the development process. Baseline specifications were available in April/May of 1999 for a system that was needed in April 2000. This did not provide sufficient lead-time to specify, develop, and test the system properly. Another issue affecting the identification of requirements was the selection criteria to determine coverage edit failure. These criteria had to be developed before some of the detailed requirements could be defined.

#### *4.2.3 No single format or document for technical specifications*

There was no single format for the development of detailed technical specifications. Different organizations within the Census Bureau such as the DSSD, DSCMO processing, and POP prepared different specifications for the CEFU program. These specifications were in different documents and formats and, due to some internal coordination problems, there was no centralized and consistent method for developing and integrating these specifications. DSCMO program management staff provided the conduit for transmission of these specifications to the contractor.

#### *4.2.4 Not all requirements were implemented*

Some requirements, although identified by the Census Bureau, were not included in CEFU. The extensive evaluation data requirements, development problems on the part of the contractor, and insufficient development time resulted in an inability to include all of the requirements in the final system. For example, variables associated with determining the length of an interview were never properly implemented and eventually dropped. Although these variables did not affect the ability of the call centers to conduct followup operations, the missing information will affect the post-census analyses that are now being performed by DSSD. Some other program requirements also were not implemented. For example, if an agent reached a household that had submitted an English form but spoke only Spanish, the case should have been redirected to a bilingual agent. This functionality was not included in the final system.

#### *4.2.5 Communications were not always effective*

During the development, there were many conference calls between the contractor and the Census team. However, due to the complexity of the specifications being discussed, these conference calls did not always provide an effective means of communication. Other modes of communication, if available, such as video conferencing or on-site visits might prove more effective when finalizing requirements and validating in-progress efforts. CEFU was a decentralized effort with planning and development work occurring at numerous locations throughout the country. The desired level of on-site presence was not achieved due to staffing limitations in some divisions at the Census Bureau.

Some Census Bureau subject matter experts believe they could have added significantly to the development process and prevented the misinterpretation of certain requirements had they been provided more direct (i.e., on-site) and frequent access to the development team. However, from the program manager's perspective, allowing subject matter experts increased access to the

contractor staff could have put the project at risk in meeting the primary objectives of the program. Recognizing this, program managers must establish priorities to ensure that contractors meet the critical objectives within the schedule and time allowed. The project plan must balance the needs of the subject matter experts with the needs of the program management function.

#### *4.2.6 Change control board used to review and prioritize changes*

A CCB was used as the forum to review proposed changes and assess the cost, technical, and schedule risks associated with those changes. As Census Bureau subject matter experts identified problems with the system or proposed changes, the CCB asked the contractor to assess the technical implications, cost impacts, and schedule risks of those changes. The results of this analysis were then presented back to the CCB. The CCB reviewed and prioritized the changes and determined what changes would be implemented by the development contractor. The CCB consisted of DSCMO and contractor staff.

#### *4.2.7 Census Bureau call strategy differs from industry*

The Census Bureau has a specific methodology for contacting households including specific days, times, and the individuals within the household that can provide the necessary information. This Census Bureau methodology is different than the standard call center methodology for contacting a household. Call centers focus on marketing and services work rather than survey and interview work. Therefore, the requirements for Census 2000 were more robust than the list management techniques and predictive dialers used at the call centers, so process changes were required. It needs to be determined whether a standard call center strategy would have improved followup results or the quality of the collected data.

### **4.3 Alignment with business processes**

This section contains findings that relate to how well CEFU supported the specific business processes that were associated with the Census Bureau's need to conduct followup for coverage edit failures.

#### *4.3.1 System perceived as effective by study participants*

More planning and additional resources could have improved the CEFU program. Even so, CEFU was the "right system for the job" as it provided an efficient and effective means to conduct followup operations. As previously mentioned, the system achieved a 70.8 percent completion rate for cases with a valid telephone number. Completes include three types of resolved cases: "count complete," "sufficient partial," and "fully complete."

#### *4.3.2 Followup operations changed significantly*

Followup operations were significantly different in Census 2000 than in prior efforts. This was the first Census to use an outbound calling program with a scripted instrument to collect the missing information. Call center technologies improved the efficiency of each agent by routing calls only after contact was made with the household. Screen “pop-ups” of the automated instrument were displayed just as the contact to the household was made. This meant that agents were using their time to collect information, not to dial and redial a particular household. The use of outbound calling for large household followup replaced the mail followup that was used in the Dress Rehearsal. In theory, automation used to support followup operations would have served to shorten the cycle time from case identification to data collection and greatly increased the response rate; however, this did not occur with CEFU because of the late program start.

#### *4.3.3 Start of CEFU operation was delayed*

The CEFU operation was scheduled to begin April 5, 2000 and be completed by June 15, 2000. The initial goal was to collect the data while the information was still fresh in the minds of the household members. Delays in development caused by resolving problems with TQA data extracts and caching resulted in the program starting on May 8, 2000. The program was extended until August 13, 2000 but, even with the extension, some cases were never finished. If the program had started on time, then extended, more cases could have been completed. The delay increased the amount of time between initial form completion and CEFU followup. Some subject matter experts expressed concern that the delay may have led to decreased data quality due to faded respondent memory.

### **4.4 System deficiencies**

This section contains findings that relate to any specific shortcomings that were identified with respect to the system’s ability to accomplish what it was supposed to do or impediments encountered during the development and support processes. Recognizing that 100 percent success is rarely achievable, it is still worthwhile to assess deficiencies in the spirit of constructively identifying “lessons learned.” Such insights can greatly contribute to improvements in future system development activities.

#### *4.4.1 Procedure required to address problems with call transfer specification*

Many Hispanic households are large households which require followup to collect information on the additional household members. When a Spanish speaking household member was contacted by an English speaking call center operator, the original intent was that the case would be transferred to a bilingual operator. The specification for this requirement was not clearly communicated to the contractor by the Census Bureau so a followup procedure was developed and implemented to address this problem.

#### *4.4.2 Testing impacted by time constraints*

Census Bureau subject matter experts produced numerous data inputs and test scenarios. Of the 162 scenarios, only 12 short form and eight long form cases were used for testing. And, not all 20 cases were tested in each of the 13 call centers used for CEFU. Due to time constraints, the original testing plans were scaled down as the deployment date approached. The limited testing made it difficult to ensure the stability of the system; a more stringent test process with numerous scenarios should have been implemented. CEFU was not subject to any Census Bureau Beta Test Site requirements due, in part, to difficulties in replicating the extensive call center infrastructure and because contractors had their own testing processes. Also, a work in progress web site was made available for the automated instrument; however, it was difficult to determine what variables were being implemented to record the data that subject matter experts needed for later evaluations.

#### **4.5 Contract management practices**

This section contains findings that relate to the effectiveness of contract administration activities. Even when system requirements are well defined, ineffective management of contractors can lead to less than optimal results when the system is deployed. Consequently, it is beneficial to evaluate past practices in order to gain insights that can lead to improvements in system development efforts. Contractors played a pivotal role in the development of CEFU. EDS was selected as the prime contractor. EDS, in turn, worked with numerous subcontractors to establish the call center infrastructure and develop the software necessary to implement the CEFU screening questions and automated instruments.

##### *4.5.1 Initial statement of work was revised*

An initial Statement of Work (SOW) was available after Dress Rehearsal in 1998 but this was not supported by sufficient requirements documentation. A Streamlined Acquisition Process (ASAP) Team was established with cross-divisional membership to rework the SOW. Specialists in the call center industry were also asked to participate in order to identify and clarify issues for the ASAP Team.

##### *4.5.2 Contract options impacted by time constraints*

There was some information as to the need for an outbound calling service in the SOW issued to the development/integration contractor; however, these requirements were not as fully defined as were the requirements for the inbound calling service. When the decision to implement telephone followup on coverage edit failures was made, it was too late to establish a new contract. The TQA developer was selected to develop and implement CEFU. Adding CEFU to the TQA contract extended the performance period for the vendor. Although the use of Census Bureau operated call centers was a potential means to meet the requirements, they did not have the total capacity (i.e., seats and agents) required for the outbound program. Piggybacking on the existing contract was deemed the only option that would enable the system to be developed and deployed within the required timeframe.

##### *4.5.3 Close working partnership established with contractor*

The project management staff and the contractor established a close working partnership to meet the project requirements and implement the system within the time constraints. Constant communication and information exchange was necessary between the two groups. This was accomplished via meetings, teleconferences, and extensive documentation. The establishment of a true partnership allowed the Census Bureau and contractor staffs to achieve the primary program objectives despite the accelerated timeline for development.

#### *4.5.4 Logistics impacted prime's ability to manage subcontractors*

As the prime, EDS was responsible for the selection and performance of all subcontractors involved in the development of CEFU. These subcontractors were located throughout the country. Because of the logistics involved, EDS was not able to maintain a stringent enough review on subcontractor activities and work products. Close to deployment, it was discovered that some products were insufficient to meet program needs; this caused EDS to send specialists to the subcontractor sites to provide both oversight and direct technical support to correct deficiencies.

#### *4.5.5 Contractor performed well despite challenges*

Overall, the EDS Team performed well to provide a quality product within a very short timeframe. Although some personnel were replaced over the course of the project, most prime and subcontract personnel were technically qualified, highly-motivated professionals capable of meeting and even exceeding development requirements and Census Bureau expectations.

## 5. RECOMMENDATIONS

This section synthesizes findings from the above sections and highlights opportunities for improvement that may apply to the Census Bureau's future system development activities. The recommendations reflect insights from the Titan/SRD analysts as well as opinions regarding "lessons learned" and internal "best practices" that were conveyed by Census Bureau personnel during interviews.

### 5.1 Project planning

The contract for the inbound calling service was put into place in December 1998. The requirements for the CEFU outbound calling service were defined by baseline specifications in April 1999 and the operation commenced in May 2000. The development for CEFU was accomplished under an extremely aggressive schedule and was being developed with many of the same Census Bureau and contractor staffs being used to develop the inbound service. These companion systems may have suffered from the fact that insufficient operational staff were available to perform both aspects simultaneously. The project team was understaffed and already hindered by limited resources. It was only through the dedicated effort of the people involved did the program get completed successfully. This type of development schedule is unrealistic because it does not allow for the full development of requirements, adequate testing, or any opportunity to accommodate unexpected program changes. Contracts must be in place early enough so that systems planned for the decennial census can be available for the Dress Rehearsal and necessary changes can be implemented and tested well before actual deployment.

*Recommendation:* Initiate development efforts early enough so that fully tested, robust systems are available for Dress Rehearsal. This is critical because of the uniqueness of many Census Bureau requirements, the complexity of the systems, and the volume of data. The purpose of the Dress Rehearsal should be to evaluate a fully functional system and fine tune system features, not to identify major changes in system functionality. Although some requirements may change from the lessons learned in Dress Rehearsal and from external forces (e.g., Congress), there would be a higher chance that all requirements would be identified and implemented for the actual census.

Realistic project timelines should be established that incorporate sufficient time for requirements definition, contract award, system development, testing, and enhancements. In addition, sufficient operational staff should be identified across programs, as pertinent, rather than on an individual project basis, in order to address the cumulative burden on operational resources.

During the planning phase, effort should be taken to evaluate industry standards for certain activities that may enhance Census Bureau capabilities or processes.

## **5.2 System development methodology**

A standardized methodology provides the agency with a framework for project planning and management and provides a contractor with guidance for the technical approach, types of documentation, and level of detail appropriate for each phase of the development life-cycle. A typical methodology covers requirements definition, system design, development, testing, deployment, and on-going maintenance phases. A standardized methodology for system development would benefit the Census Bureau by establishing the structure and procedures for the specification and development of complex systems. A standardized methodology also would help to ensure the consistency and completeness of system development efforts.

*Recommendation:* Establish an agency-wide system development life-cycle methodology using input from other federal agencies and established industry standards. This methodology should be implemented in conjunction with an organization devoted to standards and methodology development and to project management. This organization should provide training and documentation to Census Bureau personnel and representatives should be available to coach development teams through each phase of the development life-cycle.

## **5.3 Internal team coordination**

For Census 2000, the roles and responsibilities of various Census Bureau divisions were never clearly defined in advance. Also, this was the first time that the Census Bureau had done such extensive contracting to accomplish census projects. Although a cross-divisional team was convened to develop the CEFU requirements, many of these individuals perceived they were not involved in the continued specification and translation of the requirements to the contractor. Individuals working most closely with the contractor were not always the individuals who had defined the initial requirements. This may have resulted in some confusion and lack of understanding of the true intent of the requirements. In some cases, the contractor perceived these clarifications as new or changing requirements when, in fact, the requirements had been defined early in the development process.

From the program manager's perspective, efforts were made to include subject matter experts in the process, despite the time and resource constraints. In the case of CEFU, many issues were identified and resolved in a very short development life-cycle with little time available to fully coordinate and brief all members of the team. It is apparent that better communications could have improved internal team coordination for the CEFU program.

*Recommendation:* Ensure that subject matter experts stay actively involved in the continued translation of requirements and the resolution of technical issues throughout the development effort. Subject matter experts must remain an integral part of the development team to ensure that the initial intent of the requirements carry forward into the actual product. Technical issues and change request information should be circulated to appropriate parties with specific guidelines and timeframes for response. The need for internal coordination between the program managers, subject matter experts, and contractors must be addressed in the project planning stages, with roles and responsibilities clearly identified.

## **5.4 Access to development staff**

CEFU was a decentralized effort with developers located throughout the country. Limitations in project management staff size impacted the team's ability to be on-site during the development effort. Much of the communications between Census Bureau personnel and the contractor was conducted via teleconference. Although this means is suitable to discuss many issues associated with development it was not suitable for a review of interim or prototype products being developed. Subject matter experts need access to the developer to review, evaluate, and recommend changes to works in progress. During CEFU, divisions such as DSSD and POP had sufficient resources to visit contractor sites, but only one visit to the contractor involved with instrument development occurred. It is understandable that user changes must be controlled and face to face meetings tend to identify many "great ideas" that do not specifically relate to the approved requirements. In these cases, the methods to capture and prioritize recommendations used by the CCB can also be implemented to manage the recommendations from subject matter expert/contractor development sessions.

*Recommendation:* Increase the use of Joint Application Development (JAD) and Rapid Application Development (RAD) concepts for development efforts. JAD sessions bring subject matter experts and information technology specialists together early in the project to discuss and define business policies and procedures and to identify or clarify the supporting system's function, data, and performance requirements. A RAD session provides opportunities for the developer to demonstrate work in progress directly to the subject matter experts. The sessions demonstrate progress against the schedule but more importantly, provide an interactive means to solicit and record feedback on actual products. These techniques can be used in conjunction with other contractor recommended methods. Both the JAD and RAD techniques should be described in the system development methodology and addressed in each project plan, if appropriate.

The development process can also be improved by co-locating developers of critical components with the program managers and subject matter experts, resources permitting. This can enhance communications by facilitating interaction between developers and subject matter experts and improve the effectiveness of the project management function.

## **5.5 Change control board**

Census Bureau staff are used to having the freedom to make changes and provide multiple versions of the specifications because they are used to working with in-house development staff. Regardless of whether development and operation is outsourced, changes must be managed closely to avert risks and additional costs. Historically, many development projects within the Census Bureau have not been held to schedules for the delivery of specifications or any stringent change control process. In the case of CEFU, changes were subject to review by the CCB. The concept of a CCB is an effective means of identifying, assessing, prioritizing, and approving changes both in a development and production environment. Although a CCB can add some layer of bureaucracy to the process, it is essential to ensure that any changes are considered in light of the original requirements and available resources.

*Recommendation:* Continue the use of formalized change control processes as part of all development efforts. Include representatives from each stakeholder division on the board to ensure a fair assessment of the business and technical risks involved with each change. Changes should be systematically assessed in light of programmatic goals. The requirements for change control and supporting documentation should be described in the system development methodology. The change control board concept could be implemented using a two tier approach in which a high level Census Bureau board with subject matter representation controls requirements and a lower level contract control board provides information on costs, risks, and schedule implications so that the higher level board can decide whether to implement the changes. The CCB also must have adequate resources to address programs with large and complex scopes.

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